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THE STRUCTURE AND ORIGIN OF THE EXCRETORY ORGANS OF LIMULUS.

WILLIAM PATTEN.

THE coxal gland of *Limulus* has long been regarded as a ductless gland of uncertain significance, but we are now able to demonstrate that even in the adult crabs the organ is provided with a duct several millimeters in diameter and three or four inches long.

Its development also has been carefully studied, but the structure described as the developing gland proves to be the developing duct; the embryonic gland has been heretofore entirely overlooked.

In the adult the duct is so thin walled that it is not readily seen, and is very difficult to dissect. But it may be readily injected with celloidin or asphalt, so that the mass fills the duct and penetrates the lobes of the gland.

The coils of the duct may then be dissected out in the usual way, or they may be isolated by dissolving the surrounding tissues with caustic potash. When the duct is isolated by either of these methods it is seen to run straight forward along the dorso-lateral margin of the plastron, then back again, and, after many coilings, open into a large, irregular chamber, or end sac, situated in the middle of the fifth nephric lobe, *cæl*. The duct arises as a tubular outgrowth of the ventral wall of this sac, which represents a remnant of the fifth coelomic cavity; the distal end of the duct finally unites with a short ectodermic ingrowth, readily distinguished in the adult, which opens at the base of the fifth leg, *ec.p*.

The secretions from the gland are collected by gradually widening anastomosing tubules. Each of the four lobes of the gland have many separate openings into the large tubules of the longitudinal stolon, *st.*; the large tubules empty into the coelomic space, or end sac, and from these a single nephric duct carries the secretions to the external opening at the base of the fifth leg.

The glandular portion of the kidney is developed from six pairs of segmentally arranged "anlagen." Omitting all details, it may be stated that a part of the fifth coelomic cavity persists as the thin-walled chamber or end sac mentioned above. The other coelomic cavities of the thorax break down after producing, by a thickening of their neural walls, paired masses of finely granular cells. These cells become hollow and unite end to end to form irregular groups of anastomosing tubules. The

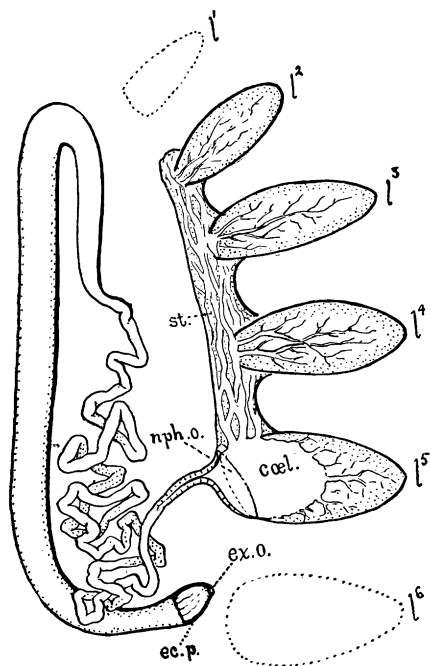


FIG. 1. — Diagram of the excretory organs of an immature *Limulus*.

tubules derived from the walls of the first and sixth coelomic cavities disappear. The remaining ones form the four lobes of the adult kidney. The longitudinal tubules of the stolon are formed in a similar manner, by the union of outgrowths from each cluster of cells. Many tubes on the periphery of the gland retain the embryonic condition in the adult. But in the center of the lobes and in the longitudinal stolon the nuclei of the tubules multiply rapidly, giving rise to a lining endothelium of flattened cells.

The kidney of *Limulus* is, therefore, derived from segmentally arranged groups of excretory cells. Each group of cells probably emptied originally into its corresponding coelomic cavity, and from there to the exterior. The separate external openings have now disappeared, and the organs are united by longitudinal tubules which finally open by a single duct, or coelomic funnel, to the exterior.

Many of the details of the above account were worked out in the biological laboratory at Dartmouth College by Miss Annah P. Hazen. They will be fully described and illustrated in a joint paper that we hope will appear at an early date in the *Journal of Morphology*.

HANOVER, N. H.,
January 17, 1898.